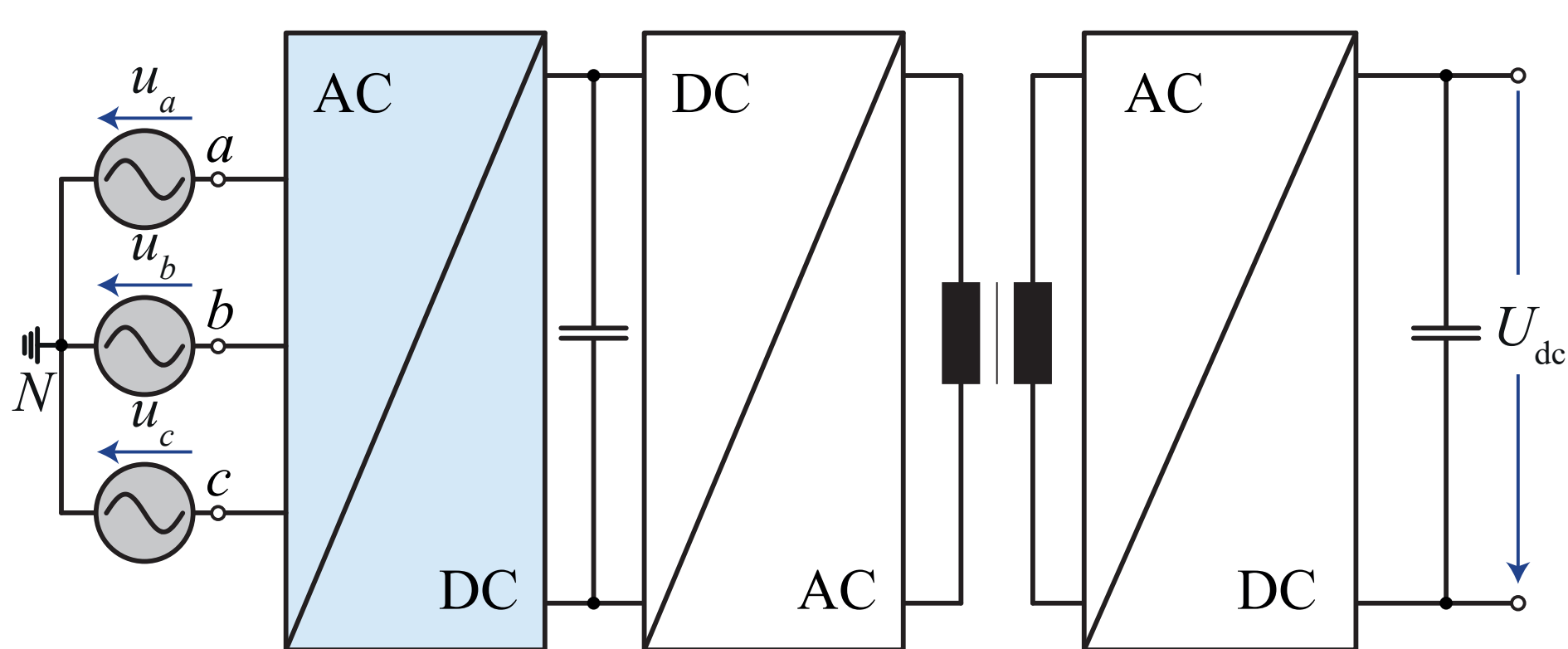


# New 600V GaN Single-Stage Isolated 400V Input Three-Phase PFC Rectifier

D. Menzi<sup>1</sup>, J. W. Kolar<sup>1</sup>, H. Sarnago<sup>2</sup>, Ó. Lucía<sup>2</sup>, J. E. Huber<sup>1</sup>  
<sup>1</sup>PES ETH Zurich, Switzerland, <sup>2</sup>University of Zaragoza, Spain  
 menzi@lem.ee.ethz.ch

## I. Isolated AC/DC Converters

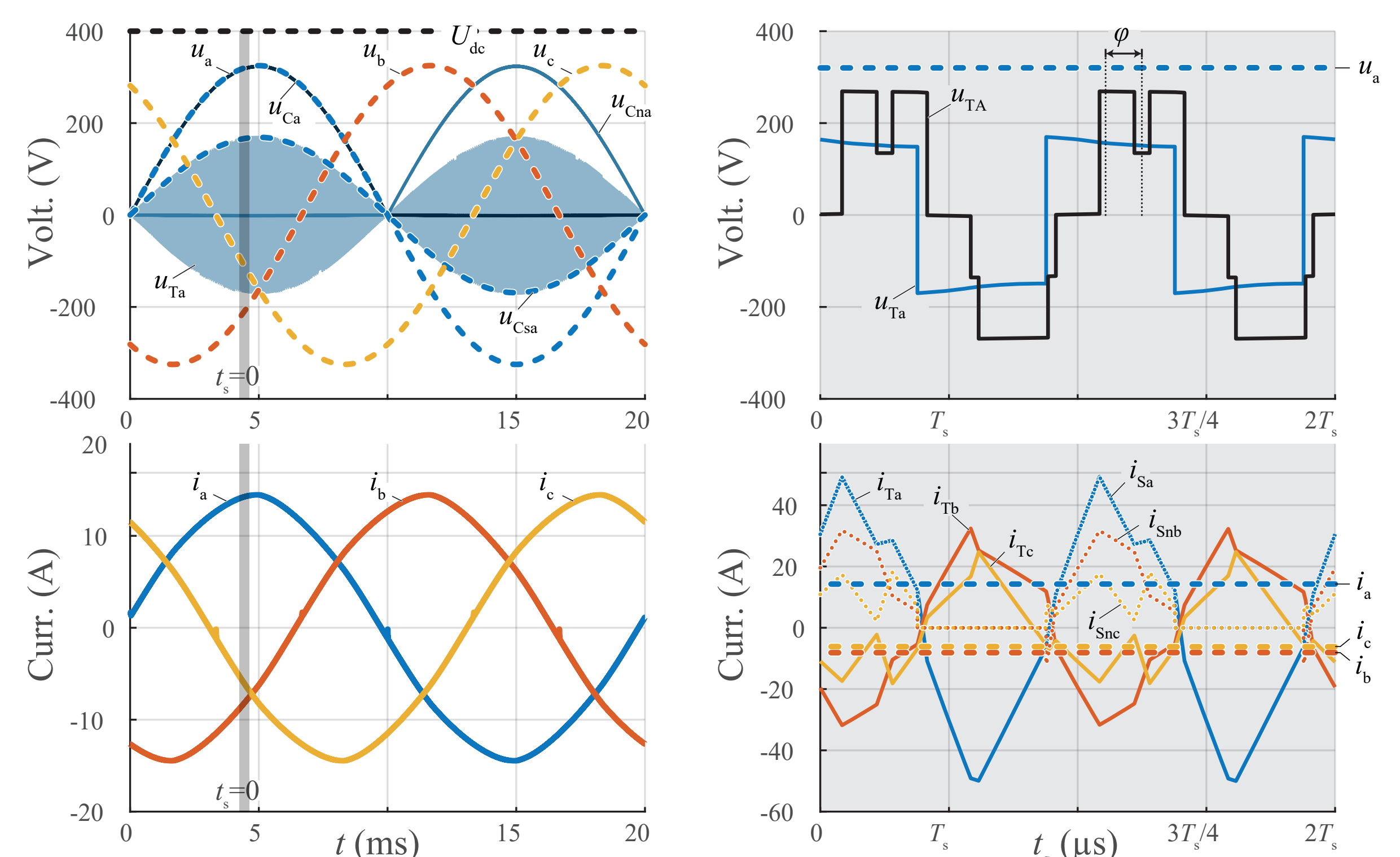
- ac-dc power conversion for, e.g., EV charging
- Requirement for HF potential separation
- Typically realized as PFC rectifier + dc-dc stage



- Two-stage energy conversion
- 800V intermediate dc-link / 1200V SiC
- High component count / volume / losses
- Alternative single-stage topologies?

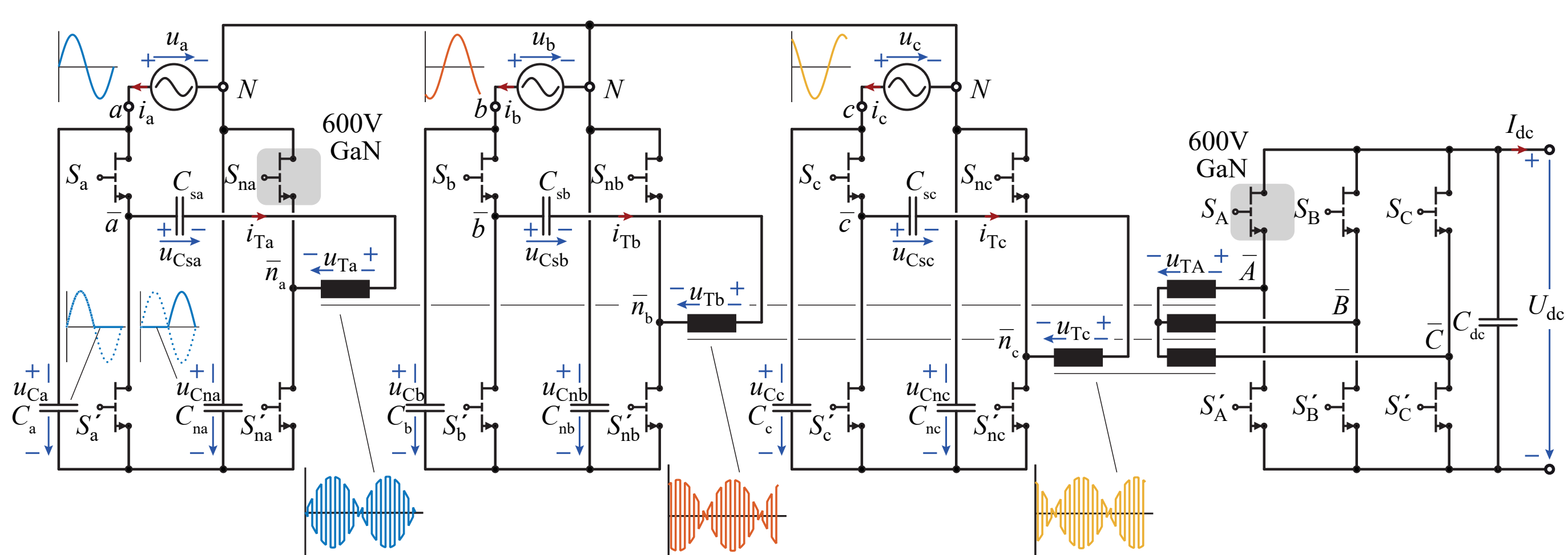
## III. DAB-Type Modulation

- Recreate primary-side voltage SV on dc-side
- DAB-type modulation / Regulate power flow with phase-shift  $\phi$
- Sinusoidal grid currents / PFC operation

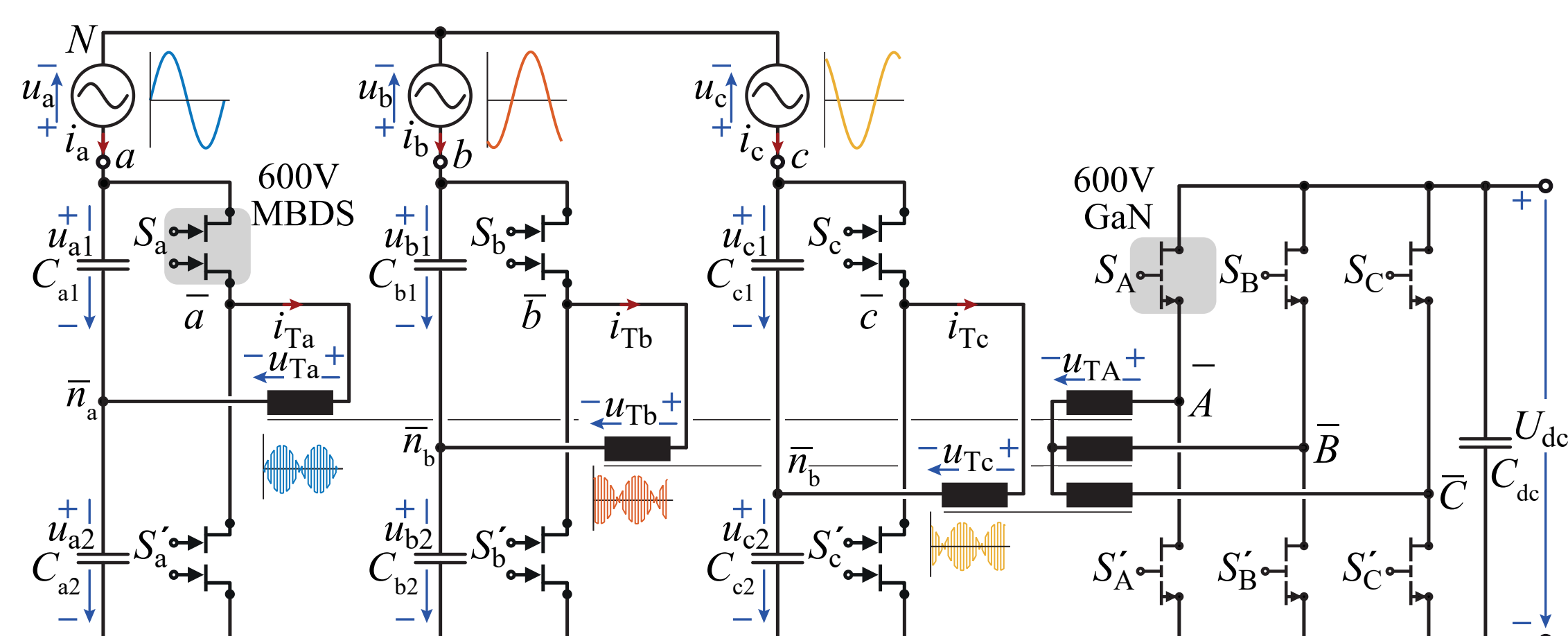


## II. Novel Single-Stage Topology

- Cycloconverter ac front-end (600V MOSFETs)
- Synchronous PWM with 50% duty cycle
- Amplitude-modulated HF DM transformer voltages

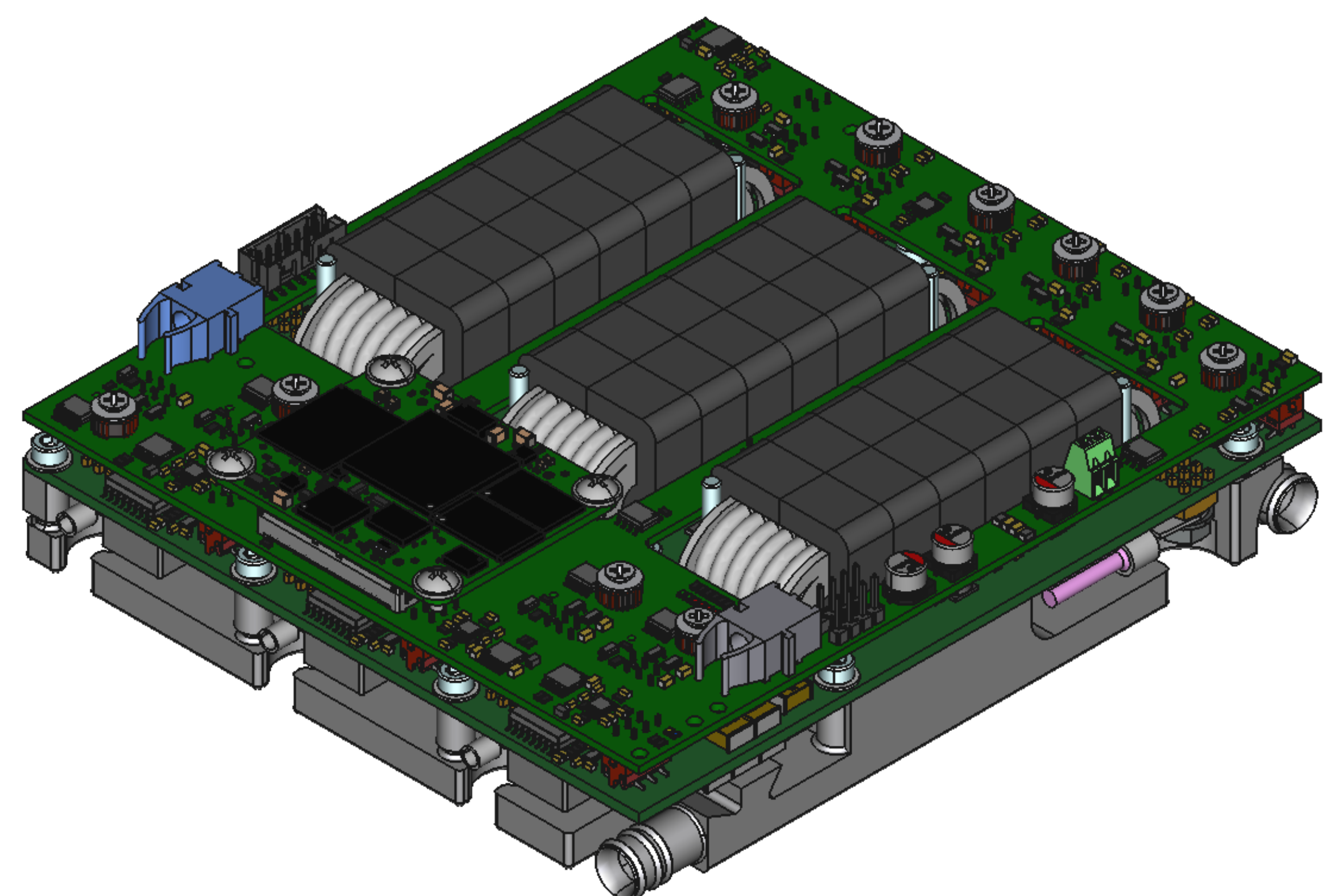


- Alternative ac front-end with 600V monolithic bidirectional switches (MBDS)
- No LF ac blocking capacitors required
- MV front-end for 4.16kV grid with 6.5kV SiC MBDS



## IV. Prototype System

- 400V ac input / 250V..450V dc output
- 6.6kW nominal output power
- Calc. efficiency: 98% / power density: 8kW/dm<sup>3</sup>



- Prototype design: J. Kaufmann, Dr. D. Zhang
- Future research vectors:
  - Advanced DAB-type modulation
  - Single-phase operation
  - SRC operation w/wo passive rectification